Cortical evoked potentials to an auditory illusion: Binaural beats (2009)

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The purpose of this study was to define cortical auditory evoked potentials to binaural beats of 3 or 6 Hz in high- (1000 Hz) and low- (250 Hz) base frequency tones, and to estimate their intracranial sources. Potentials to the onset of the tones were also recorded for comparison.

Binaural tone bursts of 2000 ms duration and 70 dBnHL intensity were presented through earphones (Sony MDR-CD770) with a flat frequency response (within 10 dB across the frequency range 100–10,000 Hz). Tones were presented at interstimulus intervals that randomly varied between 950 and 1050 ms. Low frequency tone bursts included synchronous presentation of 250 Hz to the left or right ear and 253 or 256 Hz to the opposite ear, resulting in binaural beats of 3 or 6 Hz, respectively (Fig. 1, top). Similarly, 1000 Hz tone bursts were presented to one ear and 1003 or 1006 Hz to the other, resulting in binaural beats of 3 or 6 Hz, respectively. In all, there were four stimulus conditions: 250 and 1000 Hz base frequencies with 3 and 6 Hz binaural beats, which were randomly presented during the recording session, with equal probability for each stimulus condition (25%) and right (50%) or left (50%) ear receiving the sound with the higher base frequency. Each stimulus condition was randomly presented 400 times.

Conclusions

The results of this study confirm that brain activity corresponding to an auditory illusion can be recorded from the scalp. The oscillations associated with binaural beats were larger to low- than to high frequency sound, congruent with the involvement in this illusion of 'volley principle' neural encoding. The results are in line with the suggested mechanism of binaural beats: neural volleys with slightly different frequencies from left and right ear converge and interfere in the central auditory pathway to generate beats of neural activity. The beats of neural activity recorded in this study originated in the same temporal lobe regions as onset responses, but were lateralized to the left hemisphere. Thus, potentials recorded to binaural beats involve the same brain structures, but are distinct from onset responses.